SPECIFICATION

TITLE

TELECOMMUNICATION SYSTEM AS WELL AS A METHOD FOR ITS
OPERATION

5 BACKGROUND OF THE INVENTION

Field of the Invention

1 The invention is directed to a method for the operation of a
telecommunication system having data traffic units and clock handling units in which

10 at least one part can be redundantly operated as well as to an appertaining
telecommunication system. In particular, the invention is directed to a
telecommunication system and a corresponding method in which existing
redundancies of data traffic units and clock handling units are advantageously
established.

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Description of the Related Art

2 The term telecommunication is a collective designation for all message-
oriented transmission methods with variously configured services in the
communication over greater distances between man-man, man-machine and

20 machine-machine. Telecommunication is receiving a rather particular significance
due to the merging of information and communication technology.

Telecommunication is characterized by the transmission technology with
cable transmission technology, voice and data radio, satellite technology, light
waveguide technology, modems, digital searching systems and switching technology

25 and local networks.

3 In order to enable a meaningful message exchange between two (or more)
partners, a controller is required in addition to the mere transmission of messages,
this controller defining conventions in the form of protocols that must be adhered to
for a meaningful communication. Such rules are described in, for example, the

30 service specifications of the individual levels of the OSI reference model (Open
Systems Interconnection). The OSI reference model was produced in the year 1983

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by the International Standardization Organization (ISO) proceeding from the transmission of information in the sector of data processing and has become extremely wide-spread in the meantime, in applications of communication systems as well. The OSI model merely represents principles of the message transmission

5   and consequently only defines the logic of the information flow between subscribers. Since the OSI standard contains no definitions about the physical transmission of communication, it is manufacturer-independent but needs supplementary protocols for the realization of a communication system for a more detailed definition based on other (e.g., proprietary) standards.

10   4   Fundamentally, a distinction can be made between asynchronous and synchronous communication. What is generally understood by "asynchronous communication" is the exchange of messages between a transmission entity and a reception entity that is completely decoupled in terms of time. It cannot be predicted when a transmission operation and the appertaining reception operation will be

15   initiated.

5   In contrast, what is understood by "synchronous communication" is the exchange of messages between a transmission entity and a reception entity when this exchange occurs in a fixed time grid. A transmission operation and the appertaining reception operation must thereby always be isochronically

20   implemented.

6   Telecommunication networks are characterized by the possibility of bidirectional and multi-directional data exchange between the subscribers. This assumes that each participating subscriber can communicate with every other subscriber via the same medium. The simplest realization of this is communication

25   of all subscribers in the base band. Due to the multitude of subscribers where active in parallel, it is mainly methods that statically allocate the available bandwidth to the subscribers in time-division multiplex that are utilized in this situation.

7   Due to the increase in use of light waveguide technology and the necessity of an improved intercontinental data communication and the higher performance

30   demands, the plesiochronic digital hierarchy (PDH) that has prevailed since the 1960's is being increasingly replaced by the synchronous digital hierarchy (SDH).

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The International Standard SDH enacted by the International Telecommunications Union (ITU) resulted from the American Standard SONET (Synchronous Optical Network), the standard that was developed by Bellcore in the USA and approved by the Industrial Carrier Compatibility Form (ICCF) in 1984.

5   8   Traditional telecommunication structures are based on time-division multiplex methods (TDM, time division multiplex). In contrast, ATM (asynchronous transfer mode) only sends data when its transfer is required, i.e., frames are asynchronously transmitted. The initial recommendations for ATM were published in the years 1990/91 and both the ITU as well as the ATM forum established in September 1991

10   have been concerned with the standardization of ATM.

9   Like other transmission methods, ATM is fundamentally based on a packet transmission technology. Similar to the OSI reference model, ATM is also vertically divided into several layers. Over and above this, a horizontal classification is undertaken according to aspects of the data exchange between users, aspects of

15   the communication control and management aspects. A mapping of the individual ATM layers onto the layers of the OSI reference model is not possible without further effort since the functions of the ATM layers are partly distributed over different OSI layers. In OSI terminology, ATM would be resident on the bit transmission level but also offers some additional functions of the security level.

20   10   For the transmission, ATM only uses packets having a fixed length of 53 bytes. This rigid transmission unit is referred to as an ATM cell and is composed of a header that is five bytes long as well as of 48 bytes of payload information (payload). UNI cells are distinguished from NNI cells dependent on the occupancy of the bits 5-8 of the first header byte.

25   11   In order to enable a step-by-step introduction of the ATM transmission method both in long-distance networks as well as in local networks, ATM is not bound to a specific transmission medium. The physical layer is therefore divided into a media-dependent sub-layer (PM) and a sub-layer (TC) that is independent of the transmission medium. The transmission of a cell thereby occurs in a continuous

30   cell stream. A fixed allocation between virtual ATM channels and time slots of the medium does not exist. On the contrary, a plurality of time slots are dynamically

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allocated to each virtual channel in succession dependent on the required bandwidth. The asynchronism in ATM is therefore not comprised in a time-asynchronous access onto the transmission medium but in the dynamic assigning of the bandwidth useable for a virtual channel on the basis of the plurality of required

5   time slots.

12   The direct transmission of ATM cells is the most efficient, since an additional overhead due to the adaptation to the transmission frame of the medium is eliminated, and instead, the cell stream is directly transmitted bit-by-bit. The critical disadvantage of direct cell transmission is that there is an incapability with previous

10   transmission methods in long-distance networks, since the infrastructure of these networks is based mainly on PDH and SDH systems.

13   The transmission via SDH is based on the nesting of a plurality of ATM cells in the synchronous transport modules of the SDH hierarchy. The transmission of ATM cells via SDH has previously been specified for SDH transmission rates of 155

15   Mbps and 622 Mbps (STM-1 and STM-4). Additionally, the use of the STM-16 hierarchy level with 2.5 Gbps is also provided.

14   Like an ATM transmission via SDH, the use of existing of PDH networks is also provided by the ITU. An ATM transmission via PDH hierarchy levels was standardized between 1.5 Mbps and 139 Mbps.

20   15   In telecommunication systems, circuits that are provided for the transmission, interpretation, formatting, handling and processing of payload and supplemental data are fundamentally distinguished from circuits that serve for the reception, the generation, modification, synchronization and forwarding of clock signals.

16   Telecommunication systems that have a connection to standardized

25   transmission networks like PDH, SDH or SONET usually require a synchronization in order to achieve the necessary quality at the interface to the transmission network. Two operating modes of such synchronization are distinguished. In the case of an external synchronization, a clock is directly supplied to the system from an external synchronization. In contrast, in a synchronization via the transmission path, the

30   clock is acquired from the received data stream of the interface and supplied to the system as a synchronization source. To this end, the received data frames also

include supplemental information that describe the quality of the clock signal of a collaborating party, containing this in addition to the payload information.

17   The clock quality is transmitted in timing marker bits in some interface types in plesiochronic digital hierarchy. In the case of SONET and the synchronous digital hierarchy, the quality of the clock signal is communicated in the "SSM byte" (synchronization status message).

18   Since the clock quality of a clock source with which the telecommunication system is synchronized can be variable and a reference clock can also drop out, at least two reference clocks that are redundant relative to one another are employed for synchronization of telecommunication systems. The drop-out of a reference clock must be recognized by the telecommunication and a switch must then be automatically made to the redundant reference clock.

19   In order to assure error-free data transmission in a telecommunication system, telecommunication systems exhibit redundancies both in the data traffic as well as in the clock handling. Fundamentally, a line redundancy and a board redundancy must be distinguished. For line redundancy, a line that is redundant relative to one line is established; for board redundancy, assemblies that are redundant relative to one another are present.

20   A distinction is made between 1+1, 1:1 and 1:N redundancies both in line redundancy as well as in board redundancy. Given 1+1 redundancy, both units that are redundant relative to one another (lines, assemblies) have the same information in an error-free condition. One of these units is selected as an active unit, and the other is on hand in a "hot standby" mode.

21   Given 1:1 redundancy, the two units that are redundant relative to one another carry non-identical information in an error-free condition. A determination is made as to which of the redundant units transmits or processes information having a priority that is higher than the other unit. In case of error of the unit having the higher priority, the operation of the lower-priority unit is interrupted so that the transmission or processing of the more important information can be continued.

30   Given 1:N redundancy, one low-priority unit serves N other units.

22   When a data traffic unit such as an interface card 5 (Figure) is newly configured, then the operator recites the redundancies that are desired in the telecommunication system. These redundancies are then established with software-controlled or hardware-controlled switches. Additionally, the information about the

5   redundancies that have been established are maintained in data banks.

23   To this end, the telecommunication system has a central data bank available to it in which data relating to each and every individual reference clock are also maintained in addition to information about the status of individual assemblies, alarm messages about failed units, and the plurality of reference clocks. These clock-

10   specific data comprise the specification of the interface card from which the reference clock and the payload data are taken, the priority, the current quality, and the availability of the reference clock as well as alarm messages regarding reference clocks that have dropped out.

24   In addition to the central data bank, the telecommunication system also has

15   decentralized (local) data banks available to it to which the individual units have access. These decentralized data banks are images of the central data bank but only contain those data that are required for the respective unit. When data in the central data bank are modified, the telecommunication system also updates the decentralized data banks.

20   25   Such a modification of the central data bank ensues, for example, when a peripheral processor platform (an interface card, a clock generator) or some other unit fails, the quality of a reference clock changes or a new reference clock is established.

26   In traditional telecommunication systems, the operator specifies the

25   requested redundancy both for the data traffic as well as for the clock handling upon establishment of a data traffic unit such as an interface card 5.

27   This has the disadvantage that settings are also possible where only the data traffic but not the clock handling is secured due to the presence of redundant units. Given an outage or a reduction in quality of the clock signals, a data traffic may

30   become faulty due to the shifting of clock frequencies even though redundancies had been established.

SUMMARY OF THE INVENTION

28   The invention is thus based on the object providing a method for operating a telecommunication system as well as a telecommunication system having enhanced

5   operating dependability.

29   This object is achieved by a method for operating a telecommunication system that contains data traffic units and clock handling units that can comprise both lines as well as assemblies, in which at least one part can be redundantly operated, the method comprising the steps of: defining a redundancy for a defined

10   redundancy entity, the defined redundancy entity being either at least one part of the data traffic units or at least one part of the clock handling units; establishing the defined redundancy for the defined redundancy entity; and establishing a redundancy corresponding to the defined redundancy for at least one other part which is not the defined redundancy entity.

15   30   This object is also achieved by a telecommunication system, comprising: data traffic units for implementing data traffic, the data traffic units capable of comprising lines and assemblies and capable of being redundantly operated; clock handling units for clock handling, the clock handling units capable of comprising lines and assemblies and capable of being redundantly operated; a data traffic unit

20   redundancy mechanism for establishing a redundancy of at least one part of the data traffic units; and a clock handling unit redundancy mechanism for establishing a redundancy of at least one part of the clock handling units; the data traffic unit redundancy mechanism and the clock handling unit redundancy mechanism being connected to one another such that they enable establishing the redundancy of one

25   of the mechanisms for establishing by transferring the redundancy of the other mechanism for establishing a redundancy.

31   Advantageous developments of the invention are as follows. The telecommunication system may be an ATM telecommunication system. One of the steps of establishing may comprise the step of writing at least one data bank which

30   can be a central or a local data bank. The step of establishing the redundancy corresponding to the defined redundancy may comprise a step of determining the

defined redundancy. The step of establishing the defined redundancy may be software-controlled. The step of establishing the redundancy corresponding to the defined redundancy may set this redundancy hardware-controlled. The inventive method may further comprise the step of selecting one of redundant data traffic units

5   and clock handling units. The step of defining the redundancy may ensue for at least a part of the data traffic units and a redundancy corresponding thereto is established for at least a part of the clock handling units. At least one of the defined redundancies or redundancies corresponding thereto may be a board redundancy or a line redundancy. At least one of the defined redundancies or redundancies

10 corresponding thereto may be a 1:N redundancy, which includes a 1:1 redundancy. At least one of the defined redundancies or redundancies corresponding thereto may be a 1+1 redundancy. At least one interface card may be provided which is a part of at least one part of the data traffic units, or an interface card may be provided which is a part of at least one part of the clock handling units. Finally, a clock

15 generator may be provided which is a part of at least one part of the clock handling units. These inventive aspects are explained in greater detail below or have been described above.

32   The invention particularly provides that, upon establishment of redundant units (lines, assemblies), redundancies relating both to the data traffic as well as to

20 the clock handling are always established, resulting in avoidance of sources of error and providing an enhanced failure dependability.

33   Furthermore, the invention advantageously creates a method for operating a telecommunication system as well as a telecommunication system in which the operator need not indicate an associated redundancy upon establishment of the

25 reference clock, resulting in a reduction of the work outlay. Additionally, all information about established redundancies are present at the earliest possible point in time via central and decentralized data banks.

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BRIEF DESCRIPTION OF THE DRAWINGS

34   Preferred exemplary embodiments of the invention are explained in below with reference to the sole Figure.

5   Fig.   a block schematic diagram providing overview of clock handling units of an ATM node.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

35   The lines, interface cards/data traffic units 5, and clock generators 3, 4 (which are a part of the clock handling units 1-4) shown in the Fig. can be redundantly operated. Additionally, further clock handling units can comprise redundancies. Finally, the data traffic units and lines (which are not shown in the Fig.) also comprise redundancies.

36   According to the preferred exemplary embodiment, the operator of the telecommunication system establishes a 1+1, 1:N or 1:1 redundancy of a line or of an assembly that serves the purpose of data traffic. This redundancy is deposited in a data bank. Subsequently, the redundancy of the data traffic is automatically determined with a software control and applied to the clock handling. To that end, a corresponding redundancy of the clock handling devices is set under hardware control. Subsequently, the redundant units (lines, assemblies) that have been set are established and one of the redundant units is selected for active operation. Queries of the local data bank will preferably ensue for this purpose.

37   The inventive method is preferably applied in an inventive telecommunication system for establishing a clock source that comprises a 1+1 line redundancy.

25   38   The above-described method and telecommunication system are illustrative of the principles of the present invention. Numerous modifications and adaptations will be readily apparent to those skilled in this art without departing from the spirit and scope of the present invention.

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